

PATENT COOPERATION TREATY

PCT

REC'D 27 AUG 1999

WIPO

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference JAB 1282-PCT	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP98/03189	International filing date (day/month/year) 27/05/1998	Priority date (day/month/year) 05/06/1997
International Patent Classification (IPC) or national classification and IPC A61K47/48		
Applicant JANSSEN PHARMACEUTICA N.V. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 7 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 10/11/1998	Date of completion of this report 25.08.99
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer Peris Antoli, B Telephone No. (+49-89) 2399 8476 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP98/03189

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-29 as originally filed

Claims, No.:

1-21 as originally filed

Drawings, sheets:

1/3-3/3 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP98/03189

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	6, 11
	No:	Claims	1-5, 7-10, 12-21
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-21
Industrial applicability (IA)	Yes:	Claims	1-19, 21
	No:	Claims	

2. Citations and explanations

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item VIII

Certain observations on the international application

1. The definition given on page 3, lines 13-16 of the description for the expression "glass thermoplastic phase or system", is broader than the normal meaning and scope of said the expression. [Note that according to the referred passage of the description, the system formed by all components need not be a thermoplastic glass].
- 1.2 Thus, to avoid a possible misunderstanding of the subject matter of claim 3 and that of its dependent claims 4-10, claim 3 should be so amended as to include the definition given in the description for the expression "glass thermoplastic phase".
2. For the purpose of this report, claim 3 has been read as relating to **a composition according to claim 1 or 2, wherein the components of the composition are so dispersed as to form a chemically and physically uniform or homogeneous system.**

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

3. Reference is made to the following documents:

D1 = EP-A-0 689 844
D2 = WO-A-94 12217
4. Claims 1-5, 7-10, 12-21 do not meet the requirements of Art. 33(2) PCT because their subject matter is nor new (see below).
- 4.1 D1 (see example 7) discloses slow release matrix tablets for use in medicine, said tablets comprising vinpocetine, β -cyclodextrine, methocel K4MP and tartaric acid, wherein the ratio of vinpocetine to β -cyclodextrine and to tartaric acid is no more than 2:1. Since vinpocetine in said tablets is in form of a β -cyclodextrine complex prepared by the kneading method specified in example 5 of D1, it appears that the

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP98/03189

matrix tablets will form a chemically and physically uniform/homogeneous system.

Therefore, D1 is clearly prejudicial to the novelty of the subject matter of claims 1, 2, 13-15, 17, 20 and 21; and apparently prejudicial to the novelty of the subject matter of claims 3, 5, 7, 9, and 10. [With regard to claim 21 it is to be noted that the package is no a technical feature which could characterize the claimed composition].

Should the polymer methocel K4MP have the apparent viscosity specified in the present claim 8, then D1 would also destroy the novelty of the subject matter of claims 8 and 12.

Similarly, should the tablets of D1 show the characteristics specified in the present claims 16, 18 or 19, then D1 would also destroy the novelty of the subject matter of said claims.

- 4.2 D2 (see examples 1-6) discloses therapeutic aqueous compositions comprising a sparingly water-soluble drug, 2-hydroxypropyl- β -cyclodextrin, polycarbophil, and hydrochloric acid, wherein ratio of drug to the cyclodextrine and to the acid is no more than 2:1.

Thus, D2 clearly destroys the novelty of the subject matter of the present claims 1, 2, 13, 17, 20 and 21.

Since the compositions of D2 appear to form a chemically and physically uniform or homogeneous system, D2 also appears to destroy the novelty of the subject matter of the present claims 3, 4 and 10.

Should the polycarbophil have the apparent viscosity specified in the present claim 8 and should the compositions of D2 have the characteristics specified in the present claims 16, 18 or 19, then D2 would also destroy the novelty of the subject matter of claims 8, 12, 16, 18 and 19.

5. The remaining claims 6 and 11 meet the requirements of Art. 33(2) PCT because their subject matter is formally new over the prior art cited in the search report.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP98/03189

6. Claims 1-21 do not meet the requirements of Art. 33(3) PCT for the reasons set out below.
- 6.1 The problem posed in the present application was to provide a composition that improves the biological uptake (i.e. bioavailability) of sparingly water-soluble drugs when they administered into externally voiding body cavities (e.g. the gi tract) or on topical administration.
- 6.2 According to the application (see page 1, line 18 to page 2, line 2), approaches to increase the solubility, and hence the bioavailability, of poorly water-soluble drugs include the introduction of water solubilizing groups in the drug; the increase of the surface area of the drug; or the formation of drug-cyclodextrin complexes. Said approaches have nevertheless limitations.
- 6.3 As stated in the description and as proposed in the independent main claim 1, the problem posed in the present application is solved by combining the sparingly water-soluble drug with a cyclodextrine, a water-soluble acid and a water-soluble organic polymer.
- 6.4 Example 6 of the present application evidences that capsules containing a uniform or homogeneous system comprising
- (i) a basic drug which is sparingly water-soluble;
 - (ii) a cyclodextrine;
 - (iii) a water-soluble acid; and
 - (iv) a water-soluble organic polymer,
- provide a higher oral bioavailability of the drug than
- (1) capsules containing sugar particles coated with the drug (i.e. a form wherein the surface area of the drug has been enhanced); and
 - (2) a solution of the drug that comprises 25% cyclodextrine solution.
- 6.5 However, the technical contents of the application in no way evidence that the claimed compositions could also improve the uptake of drugs which are not of basic character, nor that the claimed compositions exert unexpected or surprising effects when compared to the closest prior art (i.e. compositions according to D1 and/or D2).

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/EP98/03189

- 6.6 Thus, no inventive step can be recognised for the subject matter of the present claim 1 or that of its dependent or related claims 2-21.
7. Claims 1-19 and 21 satisfy the criterion set forth in Art. 33(4) PCT because their subject matter is susceptible of industrial application.
8. For the assessment of the present claim 20 on the question whether it is industrially applicable, no unified criteria exist in the PCT. The patentability can also be dependent upon the formulation of the claims. The EPO, for example, does not recognize as industrially applicable the subject matter of claims to the use of a compound in medical treatment, but may allow, however, claims to a known compound for first use in medical treatment and the use of such a compound for the manufacture of a medicament for a new medical treatment.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference JAB 1282-PCT	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/EP 98/ 03189	International filing date (day/month/year) 27/05/1998	(Earliest) Priority Date (day/month/year) 05/06/1997
Applicant JANSSEN PHARMACEUTICA N.V. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (see Box I).
2. ☐ Unity of invention is lacking (see Box II).
3. ☐ The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.
☐ furnished by the applicant separately from the international application,

☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

☐ Transcribed by this Authority

4. With regard to the title,

☐ the text is approved as submitted by the applicant
☒ the text has been established by this Authority to read as follows:

PHARMACEUTICAL COMPOSITIONS COMPRISING CYCLODEXTRINS

5. With regard to the abstract,

☒ the text is approved as submitted by the applicant
☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is:

Figure No. _____

☐ as suggested by the applicant.
☐ because the applicant failed to suggest a figure.
☐ because this figure better characterizes the invention.

☒ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 98/03189

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 A61K47/48 A61K9/14 A61K9/48

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, Y	EP 0 689 844 A (TECNIMEDE SOCIEDADE TECNICO ME) 3 January 1996 see the whole document ---	1, 2, 4-8, 10, 12, 13, 15, 17-21
X, Y	WO 94 12217 A (INSITE VISION INC) 9 June 1994 see the whole document ---	1, 2, 4-10, 12, 13, 15, 17-21
X	WO 90 14082 A (CIRD) 29 November 1990 see the whole document --- -/-	1, 2, 4, 7-9, 12-14, 17-21



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

11 September 1998

Date of mailing of the international search report

18/09/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Fischer, W

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/EP 98/03189

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 300 526 A (JANSSEN PHARMACEUTICA NV) 25 January 1989 see the whole document ----	5-7, 14, 17-21
Y	WO 97 18245 A (FARMAC NEDERLAND BV ;GLINTENKAMP LUETA ANN (ZA); PENKLER LAWRENCE) 22 May 1997 see the whole document ----	1, 2, 4, 5, 7, 9, 13, 14, 17-21
A	EP 0 614 666 A (STERLING WINTHROP INC) 14 September 1994 ----	
A	US 5 472 954 A (LOFTSSON THORSTEINN) 5 December 1995 ----	
A	US 4 351 846 A (MIYAKE HAJIMU ET AL) 28 September 1982 ----	
A	US 4 956 351 A (MESENS JEAN L ET AL) 11 September 1990 ----	
A	US 5 206 025 A (COURTEILLE, F. ET AL) 27 April 1993 ----	
A	WO 95 00144 A (HANHIJAERVI HANNU ;LEIRAS OY (FI); OKSALA OLLI (FI); SUHONEN PEKKA) 5 January 1995 ----	
A	EP 0 472 327 A (SENJU PHARMA CO) 26 February 1992 -----	



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : A61K 47/48, 9/14, 9/48	A1	(11) International Publication Number: WO 98/55148 (43) International Publication Date: 10 December 1998 (10.12.98)
(21) International Application Number: PCT/EP98/03189 (22) International Filing Date: 27 May 1998 (27.05.98) (30) Priority Data: 9711643.8 5 June 1997 (05.06.97) GB (71) Applicant (for all designated States except US): JANSSEN PHARMACEUTICA N.V. [BE/BE]; Turnhoutseweg 30, B-2340 Beerse (BE). (72) Inventor; and (75) Inventor/Applicant (for US only): VANDECRUYS, Roger, Petrus, Gerebern [BE/BE]; Janssen Pharmaceutica N.V., Turnhoutseweg 30, B-2340 Beerse (BE). (74) Agent: QUAGHEBEUR, Luc; Janssen Pharmaceutica N.V., Patent Dept., Turnhoutseweg 30, B-2340 Beerse (BE).		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>
(54) Title: PHARMACEUTICAL COMPOSITIONS COMPRISING CYCLODEXTRINS		
(57) Abstract <p>The invention provides a novel pharmaceutical composition comprising a no more than sparingly water-soluble drug compound, a cyclodextrin, a physiologically tolerable water-soluble acid, and a physiologically tolerable water-soluble organic polymer.</p>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

PHARMACEUTICAL COMPOSITIONS COMPRISING CYCLODEXTRINS

This invention relates to novel pharmaceutical compositions, in particular compositions and dosage forms providing improved drug release and uptake on administration into
5 externally voiding body cavities (e.g. the gi tract) or on topical administration, especially for acid solubilized drug compounds.

Many drug compounds, while possessing desired therapeutic properties, are used inefficiently due to their poor water solubilities. Thus for example where such
10 compounds are administered orally, only a small fraction of the drug is taken up into the blood during transit of the gi tract. As a result, to achieve adequate drug uptake it may be necessary to administer high doses of the drug compound, to prolong the period of drug administration or to make frequent administrations of the drug compound. Indeed, the poor solubility and hence poor bioavailability of a drug may cause an alternative
15 drug, perhaps one with undesired side effects or one which requires invasive administration (e.g. by injection or infusion), to be used in place of the poorly soluble drug.

One approach to poor solubility is to derivatise the drug molecule to introduce water solubilizing groups, e.g. ionic groups such as carboxyl groups or non-ionic groups such
20 as polyhydroxyalkyl groups, so as to produce a more soluble derivative. This approach however is not always successful as it may not be possible to maintain adequately high therapeutic efficacy and adequately low toxicity or other side effects. Thus one example of a poorly water soluble drug which has not been superseded by a solubilized derivative is the antifungal agent itraconazole.

25 Attempts have therefore been made to enhance the uptake of drugs such as itraconazole by increasing the surface area of the drug compound exposed to saliva or gastric fluid, and hence promote dissolution of the drug compound, by thinly coating the drug compound onto essentially inert carrier particles, e.g. sugar beads. This however has the drawback that the volume of solid composition required to administer a given quantity
30 of the drug compound is quite high since the carrier contributes significantly to the overall administration volume. Since administration of large volume capsules or tablets, or of large quantities of smaller volume capsules or tablets, provides difficulties for the patient, the drawbacks of this approach are obvious.

35 Yet another approach has been to administer the drug compound in the form of a solution of the drug compound and a drug complexing agent such as a cyclodextrin. This approach has limitations also in that the dosage volume is constrained by the

-2-

solubilizing power of the complexing agent, readily unitized solid dosage forms can not be used, and there is no gradual release of the drug compound for biological uptake.

5 However, we have now found that by combining such drug compounds with a cyclodextrin, a water-soluble acid and a water-soluble organic polymer, an administration form may be produced which surprisingly improves the biological uptake of the drug compound, in particular a form which can surprisingly improve the time profile for the drug content of the plasma of the patient (*i.e.* the pharmacokinetic profile defined by such parameters as AUC, t_{max} , C_{max} , etc.).

10

Thus viewed from one aspect the invention provides a pharmaceutical composition comprising a no more than sparingly water-soluble drug compound, a cyclodextrin, a physiologically tolerable water-soluble acid, and a physiologically tolerable water-soluble organic polymer.

15 Viewed from a further aspect the invention provides the use of a no more than sparingly water-soluble drug compound, a cyclodextrin, a physiologically tolerable water-soluble acid, and a physiologically tolerable water-soluble organic polymer for the manufacture of a pharmaceutical composition according to the invention for use in a method of therapy or diagnosis of the human or non-human animal (e.g. mammalian, reptilian or

20 avian) body.

Viewed from a still further aspect the invention provides a method of therapy or diagnosis of the human or non-human animal (e.g. mammalian, reptilian or avian) body which comprises administering to said body a therapeutically or diagnostically effective

25 dose of a pharmaceutical composition, the improvement comprising using as said composition a composition according to the present invention.

The compositions of the invention may if desired be aqueous, but in general will preferably be substantially water-free, e.g. containing up to 3% by weight, preferably

30 less than 1% by weight water, and most preferably less than 0.5% water, but may be mixed with water immediately before administration or may be coated and dispersed in an aqueous medium whereby the coating is only broken down after administration. Such aqueous compositions are deemed to fall within the scope of the invention. Depending on the selection of components, the compositions of the invention may be

35 liquid, solid or semi-solid - e.g. gel-like. Preferably the compositions are non-freeflowing at ambient temperature (e.g. 21°C), other than as free flowing particulates. Thus the compositions at ambient temperature are preferably solids or semi-solids or, less preferably, highly viscous fluids.

-3-

In the compositions of the invention the drug compound, acid, cyclodextrin and organic polymer are intimately admixed.

5 Thus where the composition is particulate, the acid, drug compound, cyclodextrin and organic polymer are mixed together within the particles (e.g. at the molecular level following solvent removal from a solution of these components). Granulate mixtures where individual particles do not contain all four components, or have cores of one or more components coated with other components are not preferred. This intimate
10 admixture is important since the effects of the components are complimentary at the microscopic level during dissolution of the compositions of the invention.

Preferably, all components are dispersed so as to form a system that is chemically and physically uniform or homogenous throughout, or consists of one phase as defined in
15 thermodynamics ; such a dispersion will be called a glass thermoplastic phase or system hereinafter. The components of the glass thermoplastic system are readily bioavailable to the organisms to which they are administered. This advantage can probably be explained by the ease with which said glass thermoplastic system can form liquid solutions when contacted with a body liquid such as gastric juice. The ease of
20 dissolution may be attributed at least in part to the fact that the energy required for dissolution of the components from a glass thermoplastic system is less than that required for the dissolution of components from a crystalline or microcrystalline solid phase.

25 As the cyclodextrin in the compositions of the invention, there may be used any of the physiologically tolerable water-soluble substituted or unsubstituted cyclodextrins or physiologically tolerable derivatives thereof, e.g. α -, β - or γ -cyclodextrins or derivatives thereof, in particular derivatives wherein one or more of the hydroxy groups are substituted, e.g. by alkyl, hydroxyalkyl, carboxyalkyl, alkylcarbonyl, carboxyalkoxyalkyl,
30 alkylcarbonyloxyalkyl, alkoxycarbonylalkyl or hydroxy-(mono or polyalkoxy)alkyl groups, wherein each alkyl or alkylene moiety preferably contains up to six carbons.

Substituted cyclodextrins which can be used in the invention include polyethers, e.g. as described in US Patent 3,459,731. In general, to produce these, unsubstituted
35 cyclodextrins are reacted with an alkylene oxide, preferably under superatmospheric pressure and at an elevated temperature, in the presence of an alkaline catalyst. Since a hydroxy moiety of the cyclodextrin can be substituted by an alkylene oxide which itself can react with yet another molecule of alkylene oxide, the average molar substitution

-4-

(MS) is used as a measure of the average number of moles of the substituting agent per glucose unit. The MS can be greater than 3 and theoretically has no limit. In the cyclodextrin derivatives for use in the compositions according to the present invention the M.S. is conveniently in the range of 0.125 to 10, in particular of 0.3 to 3, or from 0.3 to 1.5. Preferably the M.S. ranges from about 0.3 to about 0.8, in particular from about 0.35 to about 0.5 and most particularly it is about 0.4. M.S. values determined by NMR or IR preferably range from 0.3 to 1, in particular from 0.55 to 0.75.

Further examples of substituted cyclodextrins include ethers wherein the hydrogen of one or more cyclodextrin hydroxy groups is replaced by C₁₋₆alkyl, hydroxyC₁₋₆alkyl, carboxy-C₁₋₆alkyl or C₁₋₆alkyloxycarbonyl-C₁₋₆alkyl groups or mixed ethers thereof. In particular such substituted cyclodextrins are ethers wherein the hydrogen of one or more cyclodextrin hydroxy groups is replaced by C₁₋₃alkyl, hydroxy-C₂₋₄alkyl or carboxy-C₁₋₂alkyl or more particularly by methyl, ethyl, hydroxyethyl, hydroxypropyl, hydroxybutyl, carboxymethyl or carboxyethyl.

In the foregoing definitions, the term "C₁₋₆alkyl" is meant to include straight and branched saturated hydrocarbon radicals, having from 1 to 6 carbon atoms, such as methyl, ethyl 1-methylethyl, 1,1-dimethylethyl, propyl, 2-methylpropyl, butyl, pentyl, hexyl and the like.

Such ethers can be prepared by reacting a cyclodextrin with an appropriate O-alkylating agent or a mixture of such agents in a concentration selected such that the desired cyclodextrin ether is obtained. The reaction is preferably conducted in a solvent in the presence of a base. With such ethers, the degree of substitution (DS) is the average number of substituted hydroxy functions per glucose unit, the DS being thus 3 or less.

In the cyclodextrin derivatives for use in the compositions according to the present invention, the DS preferably is in the range of 0.125 to 3, in particular 0.3 to 2, more particularly 0.3 to 1, and the MS is in the range of 0.125 to 10, in particular 0.3 to 3 and more particularly 0.3 to 1.5.

Of particular utility in the present invention are the β -cyclodextrin ethers, e.g. dimethyl- β -cyclodextrin as described in Drugs of the Future, Vol. 9, No. 8, p. 577-578 by M. Nogradi (1984) and polyethers, e.g. hydroxypropyl- β -cyclodextrin and hydroxyethyl- β -cyclodextrin. Such alkyl ethers may for example be methyl ethers with a degree of substitution of about 0.125 to 3, e.g. about 0.3 to 2. Such a hydroxypropyl cyclodextrin may for example be formed from the reaction between β -cyclodextrin and

-5-

propylene oxide and may have a MS value of about 0.125 to 10, e.g. about 0.3 to 3.

Especially suitable cyclodextrins are β -CD, 2,6-dimethyl- β -CD, 2-hydroxyethyl- β -CD, 2-hydroxyethyl- γ -CD, 2-hydroxypropyl- γ -CD and (2-carboxymethoxy)propyl- β -CD, and in particular 2-hydroxypropyl- β -CD.

Besides simple cyclodextrins, branched cyclodextrins and cyclodextrin polymers may also be used.

- Other cyclodextrins are described for example in Chemical and Pharmaceutical Bulletin 28: 1552-1558 (1980), Yakugyo Jiho No. 6452 (28 March 1983), Angew. Chem. Int. Ed. Engl. 19: 344-362 (1980), US-3,459,731, EP-A-0,149,197, EP-A-0,197,571, US-4,535,152, WO-90/12035 and GB-2,189,245. Other references describing cyclodextrins for use in the compositions according to the present invention, and which provide a guide for the preparation, purification and analysis of cyclodextrins include the following: "Cyclodextrin Technology" by József Szejtli, Kluwer Academic Publishers (1988) in the chapter Cyclodextrins in Pharmaceuticals; "Cyclodextrin Chemistry" by M.L. Bender et al., Springer-Verlag, Berlin (1978); "Advances in Carbohydrate Chemistry", Vol. 12, Ed. by M.L. Wolfrom, Academic Press, New York in the chapter The Schardinger Dextrins by Dexter French at p. 189-260; "Cyclodextrins and their Inclusion Complexes" by J. Szejtli, Akademiai Kiado, Budapest, Hungary (1982); I. Tabushi in Acc. Chem. Research, 1982, 15, p. 66-72; W. Sanger, Angewandte Chemie, 92, p. 343-361 (1981); A.P. Croft and R.A. Bartsch in Tetrahedron, 39, p. 1417-1474 (1983); Irie et al. Pharmaceutical Research, 5, p. 713-716, (1988); Pitha et al. Int. J. Pharm. 29, 73, (1986); DE 3,118,218; DE-3,317,064; EP-A-94,157; US-4,659,696; and US-4,383,992.

More recent examples of substituted cyclodextrins include sulfobutylcyclodextrins (US-5,134,127-A). Their use is also envisaged in the present invention.

- The cyclodextrin used is preferably a β -cyclodextrin, in particular hydroxypropyl- β -cyclodextrin. The most preferred cyclodextrin derivative for use in the compositions of the present invention is hydroxypropyl- β -cyclodextrin having a M.S. in the range of from 0.35 to 0.50 and containing less than 1.5% unsubstituted β -cyclodextrin. M.S. values determined by NMR or IR preferably range from 0.55 to 0.75.

Nevertheless, the choice of cyclodextrin may be directed by the ability of the selected drug compound to be complexed by a particular cyclodextrin - thus the cyclodextrins

with greater affinity for the particular drug compound may be preferred.

5 In the compositions of the invention, the cyclodextrin is preferably present at 5 to 70% by weight, more preferably 8 to 55%, most preferably 10 to 45% by weight (relative to the total weight of cyclodextrin, acid, organic polymer and drug). The quantity of cyclodextrin used however will generally be dependent on the quantity of drug and the molar ratio of cyclodextrin to drug will preferably lie in the range 100:1 to 1:5, especially 50:1 to 1:2, more especially 10:1 to 1:1.

10 The acid used in the compositions of the invention may be any of the water-soluble physiologically tolerable acids, in particular any of the inorganic or, more preferably, organic acids conventionally used in the preparation of acid salts of drug compounds, e.g. citric, fumaric, tartaric, maleic, malic, succinic, oxalic, malonic, benzoic, mandelic and ascorbic acids.

15 Tartaric acid and more especially citric acid are preferred since the salts they form with drug compounds usually have a reduced tendency to precipitate from aqueous solutions. In general however, any acid which is not so strong as to cause degradation of the cyclodextrin and yet which is capable, on the addition of water, of generating a low pH
20 environment, preferably lower than pH 4 and ideally about pH 2, may be used. The acid may be in liquid (e.g. solution) or solid form; however acids which are solid at ambient conditions in their anhydrous or hydrate forms will generally be preferred.

In the compositions of the invention, the acid will preferably be present at 1 to 95% by
25 weight, preferably 5 to 90% by weight, more preferably 20 to 80%, and especially preferably 35 to 60% by weight (relative to the total weight of cyclodextrin, drug compound, organic polymer and acid). The amount of acid used will be dependent upon the selected acid and drug compound, but in general an increase in the relative proportion of acid will result in an acceleration of drug dissolution on contact with
30 water. The amount of acid used will normally be at least the amount necessary to form a 1:1 salt with the drug compound.

In general, the acid will form a significant proportion of dosage forms that dissolve rapidly in body fluids. Typically, they will comprise from 50 to 95% by weight of acid,
35 preferably 50 to 90% by weight, more preferably 55 to 60% by weight. Thus viewed from a further aspect the invention provides a pharmaceutical composition comprising an organic drug compound, a water-soluble physiologically tolerable acid, a water-soluble physiologically tolerable cyclodextrin and a water-soluble physiologically

-7-

tolerable organic polymer, characterised in that the weight ratios of drug compound to acid and of drug compound to cyclodextrin are no more than 2:1, preferably no more than 1.5:1, especially preferably no more than 1:1, and particularly preferably no more than 0.9:1, especially no more than 0.5:1.

5

The organic polymer used in the compositions of the invention may be any of the physiologically tolerable water soluble synthetic, semi-synthetic or non-synthetic organic polymers.

10 Thus for example the polymer may be a natural polymer such as a polysaccharide or polypeptide or a derivative thereof, or a synthetic polymer such as a polyalkylene oxide (e.g. PEG), polyacrylate, polyvinylpyrrolidone, etc. Mixed polymers, e.g. block copolymers and glycopeptides may of course be used.

15 It is believed that the effect of the organic polymer arises from an enhancement in viscosity which serves to stabilize supersaturated solutions of the drug compound on dissolution of the composition of the invention. Thus the polymer conveniently has a molecular weight in the range 500D to 2 MD, and conveniently has an apparent viscosity of 1 to 100 mPa.s when in a 2% aqueous solution at 20°C. For example, the water-soluble polymer can be selected from the group comprising

- 20
- alkylcelluloses such as methylcellulose,
 - hydroxyalkylcelluloses such as hydroxymethylcellulose, hydroxyethylcellulose, hydroxypropylcellulose and hydroxybutylcellulose,
 - hydroxyalkyl alkylcelluloses such as hydroxyethyl methylcellulose and hydroxypropyl

25

 - methylcellulose,
 - carboxyalkylcelluloses such as carboxymethylcellulose,
 - alkali metal salts of carboxyalkylcelluloses such as sodium carboxymethylcellulose,
 - carboxyalkylalkylcelluloses such as carboxymethylethylcellulose,
 - carboxyalkylcellulose esters,

30

 - starches,
 - pectins such as sodium carboxymethylamylopectin,
 - chitin derivatives such as chitosan,
 - heparin and heparinoids,
 - polysaccharides such as alginic acid, alkali metal and ammonium salts thereof,

35

 - carrageenans, galactomannans, tragacanth, agar-agar, gum arabic, guar gum and xanthan gum,
 - polyacrylic acids and the salts thereof,

-8-

- polymethacrylic acids and the salts thereof, methacrylate copolymers,
 - polyvinylalcohol,
 - polyvinylpyrrolidone, copolymers of polyvinylpyrrolidone with vinyl acetate,
 - polyalkylene oxides such as polyethylene oxide and polypropylene oxide and
- 5 copolymers of ethylene oxide and propylene oxide, e.g. poloxamers and poloxamines.

Non-enumerated polymers which are pharmaceutically acceptable and have appropriate physico-chemical properties as defined hereinbefore are equally suited for preparing

10

Particularly preferably the organic polymer is a cellulose ether, e.g. methyl cellulose, hydroxyethylmethylcellulose, or hydroxypropylmethylcellulose (HPMC), for example a Methocel® (available from Colorcon, England) such as Methocel A, Methocel E, Methocel F, Methocel K, Methocel J or Methocel HB or a Metolose® such as Metolose

15 SM, Metolose SH or Metolose SE. Especially preferably the organic polymer is a hydroxypropylmethylcellulose, e.g. from 5 cps Methocel E to 15000 cps Methocel K15M.

Even very small quantities of the organic polymer serve to achieve a beneficial effect in

20 the compositions of the invention. Thus in the compositions of the invention the organic polymer is conveniently present at 0.05 to 35% by weight, preferably 0.1 to 20%, more preferably 0.5 to 15%, and most preferably 2 to 11% by weight (relative to the total weight of drug compound, acid, cyclodextrin and organic polymer). The content and viscosity grade of the organic polymer both affect the dissolution profile for the drug

25 compound in the compositions of the invention, with increased organic polymer content and/or increased viscosity grade (e.g. 15000 mPa.s in place of 5 mPa.s (mPa.s values being at 2% aqueous solution at 20°)) both tending to decelerate drug compound dissolution). Accordingly the selection of the identity and quantity of the organic polymer will generally depend upon the dissolution profile that is desired. For example,

30 a composition that provides sustained release of the drug, will comprise a water soluble polymer having an apparent viscosity of more than 1,000 mPa.s when dissolved in a 2% aqueous solution at 20°C.

The drug compound used in the compositions of the invention may be any organic or

35 inorganic material which is no more than sparingly soluble, *i.e.* which is sparingly soluble, slightly soluble, very slightly soluble, or practically insoluble in pure water at 21°C (ie. requiring from 30, from 100, from 1000 or from 10000 parts water to put 1 part by weight drug compound into solution). In particular, the drug is a basic

compound.

Examples of such poorly water-soluble compounds that may be used in the compositions of the invention include nifedipine, itraconazole (described in EP-A-67111),
 5 saperconazole (see US-A-4916134), (-)-[2S-[2 α ,4 α (S*)]]-4-[4-[4-[4-[[2-(4-chloro-phenyl)-2-[[[(4-methyl-4*H*-1,2,4-triazol-3-yl)thio]methyl]-1,3-dioxolan-4-yl]methoxy]-phenyl]-1-piperazinyl]phenyl]-2,4-dihydro-2-(1-methylpropyl)-3*H*-1,2,4-triazol-3-one (Compound 40 in WO96/13499), cisapride (described in EP-A-76530),
 (B)-N-[4-[2-ethyl-1-(1*H*-1,2,4-triazol-1-yl)butyl]phenyl]-2-benzothiazolamine
 10 (described in WO-97/49704); methyl 6,11-dihydro-11-[1-[2-[4-(2-quinolinylmethoxy)phenyl]ethyl]-4-piperidinylidene]-5*H*-imidazo[2,1-b][3]benzazepine-3-carboxylate (described in WO-97/34897);
 4-[[4-amino-6-[(2,6-dichlorophenyl)methyl]-1,3,5-triazin-2-yl]amino]benzonitrile (described in EP-0,834,507);
 15 (B-cis)-1-[4-[4-[4-[[4-(2,4-difluorophenyl)-4-(1*H*-1,2,4-triazol-1-yl)methyl]-1,3-dioxolan-2-yl]methoxy]phenyl]-1-piperazinyl]phenyl]-3-(1-methylethyl)-2-imidazolidinone;
 (2S-cis)-1-[4-[4-[4-[[4-(2,4-difluorophenyl)-4-(1*H*-1,2,4-triazol-1-yl)methyl]-1,3-dioxolan-2-yl]methoxy]phenyl]-1-piperazinyl]phenyl]-3-(1-methylethyl)-2-
 20 imidazolidinone;
 3-[2-[3,4-dihydrobenzofuro[3,2-c]pyridin-2(1*H*)-yl]ethyl]-2-methyl-4*H*-pyrido-[1,2-a]pyrimidin-4-one;
N-[2-[4-(4-chlorophenyl)-1-piperazinyl]ethyl]-2-benzothiazolamine;
 (B1)-*N*-[4-[2-(dimethylamino)-1-(1*H*-imidazol-1-yl)propyl]phenyl]-2-benzothiazolamine
 25 (described in WO-97/49704)
 (B)-6-[amino(4-chlorophenyl)(1-methyl-1*H*-imidazol-5-yl)methyl]-4-(3-chlorophenyl)-1-methyl-2(1*H*)-quinolinone;
 (B)-*N*-[4-[2-ethyl-1-(1*H*-1,2,4-triazol-1-yl)butyl]phenyl]-2-benzothiazolamine;
 3-[6-(dimethylamino)-4-methyl-3-pyridinyl]-2,5-dimethyl-*N,N*-dipropylpyrazolo[2,3-a]-
 30 pyrimidin-7-amine monohydrochloride;
 (S)-[1-[2-[3-[(2,3-dihydro-1*H*-inden-2-yl)oxy]-4-methoxyphenyl]propyl]-1*H*-imidazol-2-yl]cyanamide; and
 (+)-(B-trans)-4-[1-[3,5-bis(trifluoromethyl)benzoyl]-2-(phenylmethyl)-4-piperidinyl]-*N*-(2,6-dimethylphenyl)-1-piperazineacetamide (S)-hydroxybutanedioate (1:1).

35

Further suitable active ingredients are those which exert a local physiological effect, as well as those which exert a systemic effect, either after penetrating the mucosa or - in

the case of oral administration - after transport to the gastro-intestinal tract with saliva. The dosage forms prepared from the compositions according to the present invention are particularly suitable for active ingredients which exert their activity during an extended period of time, i.e. drugs having a half-life of at least several hours.

- 5 Examples thereof are :
- analgesic and anti-inflammatory drugs (celecoxib, MK966, L-745,337, NSAIDs, fentanyl, indomethacin, ketoprofen, nabumetone, oxyphenbutazone, paracetamol, phenylbutazone, piroxicam, tramadol) ; anti-arrhythmic drugs (gallopamil, procainamide, quinidine, verapamil) ; antibacterial and antiprotazoal agents
- 10 (amoxicillin, ampicillin, benzathine penicillin, benzylpenicillin, cefaclor, cefadroxil, cefprozil, cefuroxime axetil, cephalixin, chloramphenicol, chloroquine, ciprofloxacin, clarithromycin, clavulanic acid, clindamycin, doxyxycine, erythromycin, flucloxacillin, halofantrine, isoniazid, kanamycin, lincomycin, mefloquine, minocycline, nafcillin, neomycin, norfloxacin, ofloxacin, oxacillin, phenoxymethyl-
- 15 penicillin, pyrimethamine-sulfadoxime, quinine, streptomycin); anti-coagulants (warfarin) ; antidepressants (amitriptyline, amoxapine, butriptyline, clomipramine, desipramine, dothiepin, doxepin, fluoxetine, fluvoxamine, gepirone, imipramine, lithium carbonate, mianserin, milnacipran, nortriptyline, paroxetine, sertraline ; 3-[2-[3,4-dihydrobenzofuro[3,2-c]pyridin-2(1*H*)-yl]ethyl]-2-methyl-4*H*-
- 20 pyrido[1,2-*a*]pyrimidin-4-one) ; anti-diabetic drugs (glibenclamide, metformin) ; antiepileptic drugs (carbamazepine, clonazepam, ethosuximide, phenobarbitone, phenytoin, primidone, topiramate, valpromide) ; antifungal agents (amphotericin, clotrimazole, econazole, fluconazole, flucytosine, griseofulvin, itraconazole, ketoconazole, miconazole nitrate, nystatin, terbinafine, voriconazole) ; antigout
- 25 (benzbromarone, probenecid) ; antihistamines (astemizole, cinnarizine, cyproheptadine, decarboethoxyloratadine, fexofenadine, flunarizine, levocabastine, loratadine, norastemizole, oxatomide, promethazine, terfenadine) ; anti-hypertensive drugs (captopril, clonidine, cyclizine, diazoxide, dihydralazine, enalapril, fosinopril, guanethidine, ketanserin, lisinopril, minoxidil, prazosin, ramipril, rescinnamine, reserpine, terazosin) ; anti-muscarinic agents (atropine sulphate, hyoscine) ; antivirals
- 30 (acyclovir, AZT, ddC, ddI, ganciclovir, loviride, tioripine, 3TC, delavirdine, indinavir, nelfinavir, ritonavir, saquinavir) ; antineoplastic agents and antimetabolites (adriamycine, cladribine, dactinomycin, daunorubicin, doxorubicin, etoposide, mitomycin, mitoxantrone, paclitaxel, taxol, taxotere, trimetrexate, vincristine,
- 35 vinblastine) ; anti-migraine drugs (alniditan, naratriptan, sumatriptan) ; anti-Parkinsonian drugs (bromocryptine mesylate, carbidopa, levodopa, selegiline) ; antipsychotic, hypnotic, anxiolytic and sedating agents (alprazolam, buspirone,

chlordiazepoxide, chlorpromazine, chlorprothixene, clozapine, diazepam, flupenthixol, fluphenazine, flurazepam, haloperidol, 9-hydroxyrisperidone, lorazepam, mazapertine, melperone, methaqualone, olanzapine, oxazepam, pimozide, pipamperone, piracetam, promazine, risperidone, selfotel, seroquel, sertindole, sulpiride, temazepam,

5 thioridazine, thiothixene, triazolam, trifluoperazine, trifluoperidol, triflupromazine, ziprasidone, zolpidem) ; anti-stroke agents (lubeluzole, lubeluzole oxide, riluzole, aptiganel, eliprodil, remacemide) ; antitussive (dextromethorphan, laevodropropizine, noscapine) ; beta-adrenoceptor blocking agents (atenolol, bupranolol, carvedilol, labetalol, metipranolol, metoprolol, nebivolol, oxprenolol, propranolol) ; cardiac

10 inotropic agents (amrinone, digitoxin, digoxin, milrinone) ; corticosteroids (beclomethasone dipropionate, betamethasone, budesonide, cortisone, dexamethasone, fludrocortisone, hydrocortisone, methylprednisolone, paramethasone, prednisolone, prednisone, triamcinolone) ; disinfectants (chlorhexidine) ; diuretics (acetazolamide, amiloride, benzthiazide, chlorothiazide, chlorthalidone, dichlorphenamide, ethacrynic

15 acid, ethoxzolamide, frusemide, hydrochlorothiazide, hydroflumethiazide, isosorbide, polythiazide, spironolactone, triamterene, trichloromethiazide) ; enzymes ; ergot alkaloids (codergocrine, ergotamine, nicergolin) ; essential oils (anethole, anise oil, caraway, cardamom, cassia oil, cineole, cinnamon oil, clove oil, coriander oil, dementholised mint oil, dill oil, eucalyptus oil, eugenol, ginger, lemon oil, mustard oil,

20 neroli oil, nutmeg oil, orange oil, peppermint, sage, spearmint, terpineol, thyme) ; gastro-intestinal agents (bromopride, cimetidine, cisapride, clebopride, diphenoxylate, domperidone, famotidine, lansoprazole, loperamide, loperamide oxide, mesalazine, metoclopramide, mosapride, nizatidine, norcisapride, olsalazine, omeprazole, pantoprazole, perprazole, pirenzepine, prucalopride, ranitidine, rabeprazole, ridogrel,

25 sulphasalazine) ; haemostatics (aminocaproic acid) ; immunosuppressants (cyclosporin A, tacrolimus) ; lipid regulating agents (atorvastatin, lovastatin, pravastatin, probucol, simvastatin) ; local anaesthetics (benzocaine, lignocaine) ; opioid analgesics (buprenorphine, codeine, dextromoramide, dextropropoxyphene, dihydrocodeine, hydrocodone, oxycodone, morphine, papaverine, pentazocine, pethidine) ;

30 parasympathomimetics (eptastigmine, galanthamine, metrifonate, neostigmine, physostigmine, tacrine, donepezil, rivastigmine, milameline, sabcomeline, talsaclidine, xanomeline, memantine, lazabemide) ; sex hormones (androgens : methyltestosterone, oxymetholone, stanozolol ; oestrogens : conjugated oestrogens, ethinyloestradiol, mestranol, oestradiol, oestriol, oestrone ; progestogens ; chlormadinone acetate,

35 cyproterone acetate, 17-deacetyl norgestimate, desogestrel, dienogest, dydrogesterone, ethynodiol diacetate, gestodene, 3-keto desogestrel, levonorgestrel, lynestrenol, medroxy-progesterone acetate, megestrol, norethindrone, norethindrone acetate,

-12-

norethisterone, norethisterone acetate, norethynodrel, norgestimate, norgestrel, norgestrienone, progesterone, quingestanol acetate) ; stimulating agents (sildenafil) ; sympathomimetics (ephedrine, clenbuterol, fenoterol, norfenefrine, pseudoephedrine) ; vasodilators (amlodipine, amyl nitrite, buflomedil, buphenine, carbocromen, diltiazem, 5 dipyridamole, glyceryl trinitrate, isosorbide dinitrate, lidoflazine, molsidomine, nicardipine, nifedipine, nimodipine, oxpentifylline, pentaerythritol tetranitrate).

Other examples include the following:

10	alpha-Lipoic acid	lactose	methylxanthine
	8-Methoxypsoralen	lithium salts	phytomenadione
	Allopurinol	magnesium salts	propylthiouracil
	alpha.-Tocopherol	menadione	
	iron salts	methylthiouracil	

15

Drug compounds suitable for use in the compositions of the invention include drugs of all types conventionally administered topically (e.g. in a gel patch) or into an externally voiding body duct, e.g. orally, nasally, aurally, rectally or vaginally. Such drugs include in particular antifungals, calcium channel blockers, antibacterials, antihypertensives, 20 antivirals, analgesics, apolipoprotein B synthesis inhibitors, and drugs which modify transit of gi tract contents (e.g. antidiarrhoea agents or motility promoters).

Indeed, the invention is particularly applicable to poorly water-soluble imidazole, triazole, imidazo-benzazepines, nitrophenyl-pyridine, *N,N'*-bisphenyl-piperazine, and *N*-phenoxyalkyl-piperidine derivatives, e.g. the compounds mentioned above and 25 compounds as described in EP-A-6711, WO96/13499 and EP-A-76530.

The compositions of the invention may conveniently contain the drug compound at 0.001 to 50% by weight, preferably 0.1 to 35%, more preferably 0.5 to 30%, especially 8 to 25% and most especially 10 to 15% by weight (relative to the total weight of acid, 30 cyclodextrin, organic polymer and drug compound). The quantity of drug will of course depend upon the desired dissolution profile, the intrinsic solubility of the drug compound and the drug dosage required where the drug is to be delivered in dosage units (e.g. capsules, coated tablets, etc).

35 Thus the present invention also provides pharmaceutical dosage forms comprising a therapeutically effective amount of a composition as described hereinbefore.

- For example if the drug is to be delivered in a standard capsule (e.g. with a 900 mg capacity for a glass thermoplastic system as described in the Examples hereto, and the desired drug dose is 100 mg/capsule) then the quantities and natures of the other composition components may be selected to give the desired drug dissolution profile - in
- 5 general only a small quantity of organic polymer, e.g. 20 to 50 mg, may be necessary, and the balance may be made up from acid and cyclodextrin with the ratio of acid to cyclodextrin being set according to the required dissolution profile, e.g. with 200 to 400 mg cyclodextrin and 450 to 650 mg acid.
- 10 Besides the drug compound, the organic polymer, the acid and the cyclodextrin, the compositions of the invention may contain other conventional pharmaceutical excipients, e.g. flavours, colouring agents, antioxidants, bulking agents, fats, waxes, coating agents, dispersants, suspension fluids (e.g. where the composition coated with a gastric juice
- 15 resistant coating and dispersed as particles in a suspension fluid such as water or a syrup), etc. Preferably such components when in intimate admixture with the drug compound will make up only a minor proportion of the composition, e.g. 0.01 to 10% by weight (relative to the total weight of acid, organic polymer, cyclodextrin and drug compound). However where the composition of the invention is encapsulated or
- 20 disposed in a carrier (e.g. a fluid or a solid or semi-solid matrix), the further components not in intimate admixture with the drug compound (e.g. coating or encapsulating materials, dispersion media, etc.) may of course make up a minor or major proportion, e.g. 5 to 95% by weight, of the overall composition.
- The compositions of the invention may be prepared by making an intimate admixture of
- 25 the drug compound, cyclodextrin, acid and organic polymer. This may be effected most straightforwardly by dissolving these components in a liquid solvent therefor and subsequently removing the solvent. Thus viewed from a further aspect the invention provides a process for the preparation of a pharmaceutical composition, said process comprising: dissolving a drug compound, a water-soluble cyclodextrin, a physiologically
- 30 tolerable water-soluble acid and a physiologically tolerable water-soluble organic polymer in a solvent; removing solvent from the resultant solution; optionally forming the resultant product into desired shapes; and optionally coating the resulting product with a physiologically tolerable coating material.
- 35 The solvent used in the process of the invention is preferably a physiologically tolerable material, suitably an organic solvent such as a C₁₋₆ alkanol (e.g. ethanol), acetone, DMF, a linear or cyclic ether (e.g. diethyl ether, dimethyl ether, or THF), cyclohexane, DMSO,

etc. or a solvent mixture that also may comprise water. For an acid with a high melting point, solvents or solvent mixtures which have high boiling points may conveniently be used; generally however the boiling point of the solvent or solvent system will be no more than about 100°C. Such solvents may be used efficiently in the production of the compositions of the invention and the level of residual solvent will be minimal. The solvent may conveniently be removed by evaporation, e.g. under reduced pressure, and as this may leave some solvent residue (e.g. up to 3% by weight) it is particularly desirable to use a solvent such as ethanol (or an ethanol-water mixture) which is a permitted pharmaceutical excipient.

10

If the drug compound is insoluble or poorly soluble in the solvent of choice, the process of the invention may involve dispersion of microparticles (e.g. nanoparticles having a particle size of 1 to 100 nm) of the drug compound in the solvent rather than full dissolution of the drug compound. If this is done, it is desirable that the drug compound particles be as small as possible. Nanoparticles of insoluble compounds may be prepared for example by various precipitation techniques or by milling with physiologically tolerable inorganic beads, e.g. of zirconia (EP-0,499,299).

15

The solvent removal may be essentially complete or it may be incomplete, in the former case to produce a solid or a gel-like solid or semi-solid, and in the latter case to produce a viscous fluid which can for example be filled into capsules.

20

In general, essentially complete solvent removal will be preferred as the resultant product can then readily be shaped. Shaping may be effected by spray-drying the solution (to provide the product in particulate form), by evaporation of solvent from solution disposed in molds, by molding (e.g. injection molding), by extrusion and the like. In general the product can be formed when hot and allowed to solidify on cooling. The shaped product may likewise be produced in film or sheet form by evaporation or by pouring a heated mass onto a plate and evaporating off the solvent.

25

30

In one preferred embodiment the product is shaped by filling into (e.g. by pouring or by extrusion) capsule shells, e.g. of gelatin.

The product may be hygroscopic, and thus may be "tacky" if touched by hand due to its absorption of moisture from the skin. Accordingly it is particularly preferred for the product to be provided with a protective coating to prevent moisture uptake during handling. Such coatings may for example take the form of capsule casings (as described above), tablet coatings, protective film or web coatings, and moisture-proof removable

35

wrappings. Tablet coatings may be applied in conventional manner and may be such as to dissolve in the mouth or stomach (e.g. sugar or sugar/beeswax coatings), or alternatively may be gastric juice resistant polymers (such as the gastric juice resistant Eudragit® coatings produced by Röhm GmbH) where it is desired that drug uptake
5 should occur in the intestines. Protective films or webs may for example be used where the product is to be applied topically, e.g. for uptake across the skin or a toe or finger nail. In this event a pad of the composition will generally be disposed between an adhesive upper protective layer and a lower removable layer. An example of a topical application form for application on nails and adjoining tissue, e.g. for the treatment of
10 fungal infection, is shown in US-A-5181914.

Where the product is produced in particulate form, e.g. by spray-drying, the particles can be loaded into water-tight administration devices (e.g. spray devices or powder dosing devices such as inhalers) for oral, nasal or topical administration of the
15 particulate. Alternatively particulates may be loaded into capsules or mixed with bulking agents such as lactose, starch, microcrystalline cellulose and mixtures thereof, and compressed to form tablets. In any event, the particles may additionally be provided with one or more coatings, e.g. to provide a delayed or prolonged release administration forms.

20 Generally however it will be preferred to shape the product into individual doses and to provide these with a protective coat, e.g. to produce a capsule, coated tablet or film covered pad single dosage unit.

25 While not wishing to be bound by theory it is thought that the advantageous drug compound dissolution profile for the compositions of the invention is achieved as a result of a combination of the effects of the components of the composition on exposure to water or aqueous body fluids. The water and the acid provide a highly acidic microenvironment in which the solubility of the drug compound is increased. This acidic
30 microenvironment contains the cyclodextrin which is capable of complexing the solubilized drug causing the production of a supersaturated solution of the drug compound and this supersaturated solution is stabilized by the viscosity enhancing effects of the organic polymer which hinders precipitation of the drug as the pH increases as the microenvironment becomes more dilute as more water enters.
35

Accordingly, in the compositions of the invention, in place of the cyclodextrin it is considered possible to use other compounds capable of complexing the drug compound, in particular host complexants capable (like cyclodextrin) of producing host:guest

complexes with the drug compound may be used. Likewise, for base solubilized drug compounds, a physiologically tolerable water-soluble base (e.g. an inorganic or organic base such as an alkali metal carbonate (eg. sodium carbonate) ethanolamine, diethanol-amine, etc.) may be used in place of the acid, and in place of the organic polymer a
5 water-soluble physiologically tolerable macromolecular (e.g. of molecular weight ≥ 1 kD) viscosity enhancer may be used; in each case in the quantities specified above for the cyclodextrin, acid and organic polymer respectively.

While the benefits of the compositions of the invention are most pronounced where the
10 drug compound is no more than sparingly soluble, the drug dissolution profiles achievable using the combination of drug, cyclodextrin and acid (or base) are such that particularly improved drug uptake profiles may be achieved even where the drug compound is more soluble. Thus viewed from an alternative aspect the invention provides a pharmaceutical composition comprising in intimate admixture a drug
15 compound, a cyclodextrin, a physiologically tolerable water-soluble acid, and a physiologically tolerable water-soluble organic polymer.

Moreover, where appropriate quantities of cyclodextrin, acid and drug compound are used, it is possible to achieve particularly desirable drug dissolution profiles where the
20 organic polymer is used in very small quantities or even omitted. Thus viewed from a further aspect the invention provides a pharmaceutical composition comprising in admixture a no more than sparingly water soluble organic drug compound, a water-soluble physiologically tolerable organic acid and a water-soluble physiologically tolerable cyclodextrin, said acid and cyclodextrin being present at 1.5 to 15 (preferably 2
25 to 10, more preferably 2.5 to 6) parts by weight and 1 to 7 (preferably 1.1 to 5, more preferably 1.25 to 4) parts by weight respectively per part by weight of said drug compound.

As has been mentioned above, the compositions according to the invention can be
30 produced with particularly favourable drug dissolution profiles. Thus dissolution may be sufficiently rapid to ensure substantially complete availability of the drug compound for biological uptake (e.g. from the mouth, nose, stomach or vagina) yet sufficiently slow to provide a more prolonged plasma uptake profile (see for example Figure 1 of the accompanying drawings) e.g. by avoidance of drug reprecipitation before the
35 composition reaches the stomach.

Such a dissolution profile is thus novel and advantageous in its own right and viewed from a further aspect the invention provides a pharmaceutical composition comprising

- an organic drug compound and at least one water-soluble physiologically tolerable excipient, characterised in that at 5, 15 and 45 minutes after addition of a quantity of said composition containing 100 mg of said drug compound to 600 mL of 0.1N hydrochloric acid at 37°C, from 7 to 25 (preferably 10 to 20, especially 12 to 18) %, 45 to 70 (preferably 50 to 65, especially 54 to 63) % and at least 96 (preferably at least 97, especially at least 98) % respectively of said drug compound is in solution in said hydrochloric acid. These figures relate to *in vitro* dissolution studies conducted in accordance with the monograph USP 23, <711> Dissolution, pp. 1791-1793.
- 10 For example, in determining the dissolution profiles set out above, the composition is placed without a coating or with a rapidly soluble coating (e.g. a gelatin capsule shell) in 0.1 N HCl (or an other appropriate medium) and the mixture is stirred using the USP-method with a paddle, apparatus 2, at a speed of 50 or 100 rpm.
- 15 The compositions according to the invention may be in any form convenient for topical administration or administration into an externally voiding body cavity (e.g. nose, lungs, mouth, ear, stomach, rectum or vagina). Typical administration forms include patches, tablets, buccal tablets, lozenges, ear-plugs, nose plugs, coated tablets, capsules, suppositories, chewing gum, gels, powders, granules, syrups and dispersions, although
- 20 patches and powders and more especially capsules and coated tablets are preferred. The drug dosage will depend upon the drug compound as well as the species and size of the subject being treated. Typically, dosages will be 0.5 to 1.2, preferably 0.8 to 1.05 times the conventional dosages for the selected drug compound administered by the same route.
- 25 Further, this invention comprises a pharmaceutical composition or a pharmaceutical dosage form as described hereinbefore for use in a method of therapy or diagnosis of the human or non-human animal body.
- 30 This invention also relates to a pharmaceutical composition for use in the manufacture of a pharmaceutical dosage form for oral administration to a mammal in need of treatment, characterized in that said dosage form can be administered at any time of the day independently of the food taken in by said mammal.
- 35 Or, in other words, the present invention also concerns the use of a pharmaceutical composition as described hereinbefore for the manufacture of a pharmaceutical dosage form for oral administration to a mammal in need of treatment, characterized in that said

-18-

dosage form can be administered at any time of the day independently of the food taken in by said mammal.

5 This invention also relates to a method of therapy or diagnosis of the human or non-human animal body which comprises administering to said body a therapeutically or diagnostically effective dose of a pharmaceutical composition according to any one of claims 1 to 12.

10 This invention also relates to a pharmaceutical package suitable for commercial sale comprising a container, an oral dosage form as claimed in any one of claims 12 to 17, and associated with said package written matter non-limited as to whether the dosage form can be administered with or without food.

15 The invention will now be described further with reference to the following non-limiting Examples and the accompanying drawings, in which:

Figures 1 and 2 are graphs showing plasma concentrations of the drug (-)-[2S-[2 α ,4 α (S*)]]-4-[4-[4-[4-[[2-(4-chlorophenyl)-2-[[4-methyl-4*H*-1,2,4-triazol-3-yl)thio]methyl]-1,3-dioxolan-4-yl]methoxy]phenyl]-1-piperazinyl]phenyl]-2,4-dihydro-2-(1-methylpropyl)-3*H*-1,2,4-triazol-3-one administered in a composition according to the invention and in a conventional administration form (sugar particles coated with the drug and loaded in a gelatin capsule) [see Example 6 for further details]; and

25 Figure 3 is a dissolution profile for the three itraconazole compositions of Example 2.

Example 1

Glass thermoplastic system composition preparation

The following ingredients are mixed in a 250 mL glass flask:

30	Drug compound (e.g. itraconazole)	20 g
	Citric acid monohydrate	100 g

Anhydrous ethanol (100 mL) is added. The glass flask is placed on a steam bath (bain marie) and stirred at 70°C until the drug and acid are completely dissolved (about 10 minutes). Thereafter the following ingredients are added:

35	Hydroxypropyl- β -cyclodextrin	50 g
	Hydroxypropylmethylcellulose (2910.5 mPa.s)	10 g

The flask is placed on the steam bath and stirred at 70°C until dissolution is complete

(about 70 minutes). The solution is then poured onto cleaned stainless steel plates which are then placed in a drying oven for 2 hours at 80°C under vacuum and subsequently for 40°C under vacuum overnight. The plates are then heated to 80°C and the gel residue is scraped off and filled into 900 mg capacity gelatin capsules (size no. 0).

Example 2

Composition preparation

Analogously to Example 1, gelatin capsules having the following relative weights of components are prepared:

- | | | |
|------|--------|--|
| (A) | 100 mg | Itraconazole |
| | 500 mg | citric acid monohydrate |
| | 275 mg | hydroxypropyl- β -cyclodextrin |
| | 25 mg | Methocel E5 |
| (B) | 100 mg | Itraconazole |
| | 500 mg | citric acid monohydrate |
| | 250 mg | hydroxypropyl- β -cyclodextrin |
| | 50 mg | Methocel E5 |
| (C) | 100 mg | Itraconazole |
| | 500 mg | citric acid monohydrate |
| | 225 mg | hydroxypropyl- β -cyclodextrin |
| | 75 mg | Methocel E5 |
| (D)* | 200 mg | Methyl 6,11-dihydro-11-[1-[2-[4-(2-quinolinylmethoxy)phenyl]ethyl]-4-piperidinylidene]-5H-imidazo[2,1-b]-[3]benzazepine 3-carboxylate |
| | 650 mg | citric acid monohydrate |
| | 250 mg | hydroxypropyl- β -cyclodextrin |
| (E) | 100 mg | (-)-[2S-[2 α ,4 α (S*)]]-4-[4-[4-[4-[2-(4-chlorophenyl)-2-[(4-methyl-4H-1,2,4-triazol-3-yl)thio]methyl]-1,3-dioxolan-4-yl]methoxy]-phenyl]-1-piperazinyl]phenyl]-2,4-dihydro-2-(1-methylpropyl)-3H-1,2,4-triazol-3-one |
| | 500 mg | citric acid monohydrate |
| | 250 mg | hydroxypropyl- β -cyclodextrin |
| | 50 mg | Methocel E5 |

-20-

* For example 2(D) the composition is loaded into 1100 mg gelatin capsules.

The dissolution profiles of the gels of Example 2(A), (B) and (C) are shown in Figure 3 of the accompanying drawings. These were determined by placing one capsule
 5 containing 100 mg of itraconazole in 300 mL of stirred 0.1 N HCl at 37°C and observing the percentage of dissolved drug compound at times 0, 5, 15, 30, 45 and 60 minutes (stirring was effected using the USP-method with paddle, apparatus 2, 100 rpm). For Example 2(E), with 100 mg drug compound added to 600 mL of 0.1 N HCl at 37°C, the mean percentages of drug compound in solution at 5, 15, 30 and 45
 10 minutes were 17.22, 61.18, 92.73 and 98.67 respectively (stirring was effected using the USP-method with paddle, apparatus 2, 100 rpm).

The dissolution profile of Example 2(E) was compared with that of a conventional capsule dosage form in which the gelatin capsule is loaded with sugar particles coated
 15 with 100 mg of (-)-[2S-[2 α ,4 α (S*)]]-4-[4-[4-[[2-(4-chlorophenyl)-2-[[4-methyl-4H-1,2,4-triazol-3-yl]thio]methyl]-1,3-dioxolan-4-yl]methoxy]phenyl]-1-piperazinyl]-phenyl]-2,4-dihydro-2-(1-methylpropyl)-3H-1,2,4-triazol-3-one. The capsules were placed in 10 ml of 0.1 N HCl at 37°C in glass vials and shaken in a mechanical shaker (100 strokes per minute) and the percentage of drug compound in solution after 0,
 20 30 and 60 minutes was determined. The results are set out in Table 1 below.

Table 1

<u>Percentage of drug compound in solution</u>			
	Time	Example 2(E)	Conventional Capsule
25	0	0	0
	30	91.26	15.54
	60	101.90	18.39

30 This clearly shows how much more readily the drug compound is made bioavailable by the compositions of the invention.

Example 3

Effect of organic polymer on supersaturation stability

Aqueous solutions of hydroxypropyl- β -cyclodextrin (HP β CD) and Methocel E5 in
 35 300 ml 0.1 N HCl at 37°C were prepared having the concentrations set out in Table 2. The solutions were stirred using the USP-method with paddle, apparatus 2, 150 rpm.

-21-

	<u>Sample</u>	<u>HPβCD (mg)</u>	<u>Methocel E5 (mg)</u>
	1	250	250
	2	500	0
	3	250	00
5	4	500	500
	5	0	250
	6	500	250
	7	0	0
	8	250	0
10	9	0	500

To these solutions, with stirring, a concentrated solution of itraconazole in DMF (50 mg/mL) was added dropwise until precipitation was observed. Subsequently the concentration of dissolved itraconazole expressed in mg% (ie. the number of mg dissolved in 100 mL) was observed at 0, 30, 60 and 120 minutes. The results are set out in Table 3 below:

Table 3Percentage of drug compound in solution

20	Sample Time (minutes)	1	2	3	4	5	6	7	8	9
	0	59.52	72.10	58.95	75.47	42.65	75.27	42.60	60.95	42.95
	30	62.02	74.40	62.05	78.12	44.85	80.17	44.10	62.92	45.20
25	60	62.52	70.37	62.50	79.47	45.40	80.40	44.97	64.07	46.00
	120	62.79	45.82	63.90	80.77	46.55	81.25	31.32	33.65	47.05
	HPBCD:	1:1	2:0	1:2	2:2	0:1	2:1	0:0	1:0	0:2
	Methocel ratio									

30 These results clearly demonstrate (i) the solubilizing effect of the cyclodextrin (Samples 2, 6 and 4 show the highest initial itraconazole concentrations, followed by Samples 8, 1 and 3, with Samples 7, 5 and 9 showing the lowest initial concentrations) and (ii) the stabilizing effect of the organic polymer (Samples 2, 8 and 7 show the greatest drop in itraconazole concentrations over 120 minutes, etc).

Example 4Extended release formulation

Analogously to Example 1, gelatin capsules were prepared containing the following:

-22-

41.55 mg	Cisapride
508.45 mg	citric acid monohydrate
250 mg	hydroxypropyl- β -cyclodextrin
100 mg	Methocel K15M

5

This formulation has a much slower dissolution rate than the compositions of Example 2. However the rate of dissolution is much more close to linear with time and shows much less dependence on the pH of the dissolution medium.

10 Example 5Nail gel

A gel for application to nails or hooves to effect antifungal treatment is made with the following composition:

	Itraconazole	250 mg
15	Citric acid monohydrate	2083 mg
	Hydroxypropyl- β -cyclodextrin	333 mg
	Hydroxypropylmethylcellulose (Methocel E5)	83 mg
	Anhydrous ethanol	2 ml

20 Example 6Body uptake

The plasma concentrations of R 103757 were determined in healthy humans at 0, 1/2, 1, 1 1/2, 2, 3, 4, 6, 8 and 12 hours after oral administration of 100 mg (-)-[2S-[2 α ,4 α (S*)]]-4-[4-[4-[4-[2-(4-chlorophenyl)-2-[[4-methyl-4*H*-1,2,4-triazol-3-yl)-thio]methyl]-1,3-dioxolan-4-yl]methoxy]phenyl]-1-piperazinyl]phenyl]-2,4-dihydro-2-(1-methylpropyl)-3*H*-1,2,4-triazol-3-one as (i) a 5 mg/mL oral solution containing 25% hydroxypropyl- β -cyclodextrin solution administered under fasting conditions, (ii) a conventional capsule containing (-)-[2S-[2 α ,4 α (S*)]]-4-[4-[4-[4-[2-(4-chlorophenyl)-2-[[4-methyl-4*H*-1,2,4-triazol-3-yl)thio]methyl]-1,3-dioxolan-4-yl]methoxy]phenyl]-1-piperazinyl]phenyl]-2,4-dihydro-2-(1-methylpropyl)-3*H*-1,2,4-triazol-3-one coated onto sugar particles administered under fasting conditions, (iii) a conventional capsule containing (-)-[2S-[2 α ,4 α (S*)]]-4-[4-[4-[4-[2-(4-chlorophenyl)-2-[[4-methyl-4*H*-1,2,4-triazol-3-yl)thio]methyl]-1,3-dioxolan-4-yl]methoxy]phenyl]-1-piperazinyl]phenyl]-2,4-dihydro-2-(1-methylpropyl)-3*H*-1,2,4-triazol-3-one coated onto sugar particles administered after a standard breakfast, (iv) a capsule according to Example 2(E) administered under fasting conditions and (v) a capsule according to Example 2(E) administered after a standard breakfast.

The "standard breakfast" comprised four slices of bread, one slice of ham, one slice of cheese, butter, jelly and two cups of coffee or tea with milk and/or sugar if desired.

5 The 100 mg dose of (-)-[2S-[2 α ,4 α (S*)]]-4-[4-[4-[2-(4-chlorophenyl)]-2-[(4-methyl-4*H*-1,2,4-triazol-3-yl)thio]methyl]-1,3-dioxolan-4-yl]methoxy]phenyl]-1-piperazinyl]phenyl]-2,4-dihydro-2-(1-methylpropyl)-3*H*-1,2,4-triazol-3-one was administered just after such a breakfast.

10 Blood samples of 10 mL were taken to obtain 5 mL plasma. The blood samples were taken, collected in heparinized tubes, and centrifuged at 1000g for 10 minutes within 2 hours of collection. Plasma was transferred into plastic tubes, which were sealed and stored at -70°C until assayed.

15 The results are shown in Figures 1 and 2 which presents drug concentrations as a function of time. As can be seen, the conventional capsule performs significantly worse than the solution even with fasting. However the capsule according to the invention outperforms the solution after 3 hours whether or not the recipient has fasted and, most surprisingly, completely outperforms the solution where the recipient has not fasted.

20

Example 7

Effect of pH on dissolution rate

25 Following the procedure of Example 1, a placebo capsule comprising methylene blue (2,63 mg), citric acid (600 mg), hydroxypropyl- β -cyclodextrin (250 mg) and hydroxypropylmethylcellulose (Methocel E5, 50 mg) was prepared. The dissolution of these capsules was determined at various pH values according to the USP method (600 ml medium, 37°C, Apparatus 2 with paddle, 100 rpm). The six media tested were : 0.1N HCl (pH 1.55), 0.01N HCl (pH 2.25), 0.001N HCl (pH 2.75), USP pH 4.5 (pH 4.40), USP pH 6.5 (pH 5.80) and USP pH 7.5 (pH 7.0).

30

The results are set out in **table 4** below :

Time (min.)	0.1N HCl	0.01N HCl	0.001N HCl	USP pH 4.5	USP pH 6.5	USP pH 7.5
0	0.00	0.00	0.00	0.00	0.00	0.00
5	16.62	21.85	16.62	21.40	15.48	16.62
15	60.77	73.75	74.43	71.93	60.55	62.59
30	95.60	104.25	104.93	100.15	102.20	100.83
45	100.83	104.93	105.39	104.48	103.57	104.25
60	102.43	104.70	104.93	105.16	104.48	104.02
pH	1.55	2.25	2.75	4.40	5.80	7.00

Example 8

- 5 Following the procedure of Example 1, various drug containing capsules were made having the following relative weights of components :
 - A. 100 mg itraconazole
500 mg citric acid
250 mg hydroxypropyl- β -cyclodextrin
10 50 mg HPMC E5
 - B. 200 mg methyl 6,11-dihydro-11-[1-[2-[4-(2-quinolinylmethoxy)phenyl]ethyl]-4-piperidinylidene]-5*H*-imidazo[2,1-*b*][3]benzazepine-3-carboxylate
650 mg citric acid
250 mg hydroxypropyl- β -cyclodextrin
 - 15 C. 100 mg (-)-[2*S*-[2 α ,4 α (*S**)]]-4-[4-[4-[4-[[2-(4-chlorophenyl)-2-[[4-methyl-4*H*-1,2,4-triazol-3-yl]thio]methyl]-1,3-dioxolan-4-yl]methoxy]phenyl]-1-piperazinyl]phenyl]-2,4-dihydro-2-(1-methylpropyl)-3*H*-1,2,4-triazol-3-one
500 mg citric acid
20 250 mg hydroxypropyl- β -cyclodextrin
50 mg HPMC E5
 - D. 100 mg 4-[[4-amino-6-[(2,6-dichlorophenyl)methyl]-1,3,5-triazin-2-yl]amino]-benzonitrile
500 mg citric acid
25 250 mg hydroxypropyl- β -cyclodextrin
50 mg HPMC E5
 - E. 5 mg (B)-N-[4-[2-ethyl-1-(1*H*-1,2,4-triazol-1-yl)butyl]phenyl]-2-benzo-

-25-

thiazolamine

500 mg citric acid

395 mg hydroxypropyl- β -cyclodextrin

F. 100 mg (B-cis)-1-[4-[4-[4-[[4-(2,4-difluorophenyl)-4-(1*H*-1,2,4-triazol-1-yl)-methyl]-1,3-dioxolan-2-yl]methoxy]phenyl]-1-piperazinyl]phenyl]-3-(1-methylethyl)-2-imidazolidinone

500 mg citric acid

250 mg hydroxypropyl- β -cyclodextrin

50 mg HPMC E5

The dissolution of these compositions was determined according to the USP method (600 ml 0.1 N HCl, 37°C, Apparatus 2 with paddle, 100 ppm), except formulation (A) where only 300 ml medium was used. The results are set out in the following tables 5-10 :

Table 5 : Formulation (A)

Time (min)	sample 1	sample 2	sample 3
0	0.00	0.00	0.00
5	10.75	9.99	10.69
15	56.61	57.18	59.61
30	85.89	88.98	90.24
45	95.46	99.84	96.87
60	101.94	102.06	102.87

Table 6 : Formulation (B)

Time (min)	0.1N HCl	0.01N HCl	0.001N HCl
0	0.00	0.00	0.00
5	27.00	25.17	21.39
15	92.13	86.94	84.75
30	97.11	96.63	93.09
45	98.64	99.45	94.83
60	100.29	100.08	95.28

Table 7 : Formulation (C)

Time (min)	Calculated concentration in % of the active dose						
	sample 1	sample 2	sample 3	sample 4	sample 5	sample 6	average
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	13.81	17.28	17.67	19.79	18.56	16.19	17.22
15	58.44	59.10	66.60	63.42	62.46	57.06	61.18
30	92.34	92.94	93.36	92.46	92.52	92.76	92.73
45	98.28	98.94	98.82	99.30	98.52	98.16	98.67
60	100.08	99.54	99.66	100.20	100.02	99.96	99.91

Table 8 : Formulation (D)

5

Time (min)	Calculated concentration in % of the active dose	
	Sample 1	
5	0.00	
5	7.41	
15	49.49	
30	86.92	
45	99.57	
60	99.84	
90	101.77	
120	103.52	
150	103.70	

Table 9 : Formulation (E)

Time (min)	Calculated concentration in % of the active dose		
	0.1N HCl	0.01N HCl	0.001 N HCl
0	0.00	0.00	0.00
5	48.72	26.16	24.96
15	100.92	96.36	94.20
30	102.48	98.76	95.76
45	103.08	102.24	96.96
60	102.00	102.00	97.80

Table 10 : Formulation (F)

Time (min)	Calculated concentration in % of the active dose						
	sample 1	sample 2	sample 3	sample 4	sample 5	sample 6	average
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	12.66	14.76	12.66	12.66	15.36	17.34	14.24
15	54.36	56.82	61.98	64.80	54.78	63.78	59.42
30	94.26	93.96	97.50	98.40	95.58	97.20	96.15
45	100.98	101.28	100.50	101.16	100.68	101.34	100.99
60	101.22	101.34	101.16	101.52	100.86	101.58	101.28

Example 95 **Stability testing of formulation 8 (C)**

Capsules of formulation 8(C) were stored for 1 month and 3 months at 40°C, and for 1 year at room temperature. Dissolution measurements were made according to the USP method (600 ml 0.1N HCl, 37°C, paddle apparatus 2,100 rpm).

The following results were obtained :

10

Table 11 : after 1 month at 40°C

Time (min)	Calculated concentration in % of the active dose						
	sample 1	sample 2	sample 3	sample 4	sample 5	sample 6	average
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	10.11	10.79	9.94	9.59	14.35	10.33	10.85
15	59.72	55.02	48.97	54.36	66.54	52.38	56.17
30	93.00	90.06	89.70	92.70	95.46	89.16	91.68
45	100.14	98.22	98.94	99.84	99.48	99.18	99.30
60	100.50	100.92	99.36	99.54	100.56	100.26	100.19

Table 12 : after 3 months at 40°C

15

Time (min)	Calculated concentration in % of the active dose						
	sample 1	sample 2	sample 3	sample 4	sample 5	sample 6	average
	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5.74	5.90	13.93	11.49	7.56	7.78	8.73
	43.62	45.00	56.76	48.30	43.14	47.76	47.43
	88.80	89.10	89.70	87.96	84.54	84.42	87.42
	99.36	99.96	99.54	99.78	99.18	100.08	99.65
	100.32	100.14	100.92	100.44	101.70	100.50	100.67

Table 13 : after 1 year at room temperature

Time (min)	Calculated concentration in % of the active dose			
	sample 1	sample 2	sample 3	average
0	0.00	0.00	0.00	0.00
5	14.94	16.14	15.48	15.52
15	61.98	66.12	67.32	65.14
30	92.52	91.86	96.12	93.50
45	99.72	99.60	98.70	99.34
60	101.10	100.80	99.36	100.42

5 Example 10Variability in bioavailability of Formulation (D)

The variability in the bioavailability of Formulation (D) in beagle dogs was evaluated as follows. First, two beagle dogs received as single oral administration of a PEG-400 solution comprising 4-[[4-amino-6-[(2,6-dichlorophenyl)methyl]-1,3,5-triazin-2-yl]amino]benzonitrile at a dose of 10 mg/kg. Plasm levels were measured for 32 hours.

After 7 days, the same dogs were now treated with a single oral capsule comprising the formula (D) at 10 mg/kg. Plasm levels were again determined for up to 32 hours after administration. The individual results are as follows.

15

Formulation	Day	Time	Plasma levels (ng/ml)	
			Dog 1	Dog 2
PEG-400 solution	0	0 h	5.8	NQ
		0.5 h	141	63.2
		1 h	247	158
		2 h	291	141
		4 h	534	200
		6 h	368	171
		8 h	246	141
	1	24 h	95.2	47.4
		32 h	36.1	20.9

-29-

Formulation	Day	Time	Plasma levels (ng/ml)	
			Dog 1	Dog 2
GTS capsule	7	0 h	NQ	NA
		0.5 h	24.2	68.5
		1 h	567	600
		2 h	850	859
		4 h	461	492
		6 h	288	343
		8 h	237	207
	8	24 h	74.0	32.9
		32 h	32.7	10.1

NQ : not quantifiable by the HPLC method (< 5.0 ng/ml).

Surprisingly, the plasm levels obtained after administration of the capsules comprising formula (D) are very much more similar to one another in the two test animals than
 5 those obtained after administration of the PEG 400 solution.

Example 11

Permeation and accumulation of itraconazole through and in human skin

A Franz cell was fitted with fresh whole human skin and its receptor filled with a 20%
 10 (w/v) solution of hydroxypropyl- β -cyclodextrin in water. A Finn Chambers patch was filled with Formulation 8(A) and was then placed on the skin wetted with a small amount of phosphate buffered saline. Samples of the receptor solution were withdrawn at regular intervals and the presence of itraconazole in the solution was measured using high performance liquid chromatography. At no time point could any
 15 trace of itraconazole be detected, indicating that this compound did not penetrate whole human skin. At the end of the experiment the skin was thoroughly washed and then extracted in order to determine the amount of itraconazole accumulated in the skin. A mean value of 12.2 $\mu\text{g}/\text{cm}^2$ could be calculated from the results of 8 independent experiments.

Claims

1. A pharmaceutical composition comprising a no more than sparingly water-soluble drug compound, a cyclodextrin, a physiologically tolerable water-soluble acid, and a
5 physiologically tolerable water-soluble organic polymer.
2. The composition of claim 1 characterised in that the weight ratios of drug compound to acid and of drug compound to cyclodextrin are no more than 2:1.
- 10 3. The composition of claim 1 or 2 characterized in that the physical state of said composition is a glass thermoplastic phase.
4. The composition of claim 3 wherein the cyclodextrin is 2-hydroxypropyl- β -cyclodextrin.
- 15 5. The composition of claim 3 wherein the acid is selected from the group comprising citric, fumaric, tartaric, maleic, malic, succinic, oxalic, malonic, benzoic, mandelic and ascorbic acid.
- 20 6. The composition of claim 5 wherein the acid is citric acid.
7. The composition of claim 3 wherein the polymer is selected from the group comprising
 - alkylcelluloses such as methylcellulose,
 - 25 - hydroxyalkylcelluloses such as hydroxymethylcellulose, hydroxyethylcellulose, hydroxypropylcellulose and hydroxybutylcellulose,
 - hydroxyalkyl alkylcelluloses such as hydroxyethyl methylcellulose and hydroxypropyl methylcellulose,
 - carboxyalkylcelluloses such as carboxymethylcellulose,
 - 30 - alkali metal salts of carboxyalkylcelluloses such as sodium carboxymethylcellulose,
 - carboxyalkylalkylcelluloses such as carboxymethylethylcellulose,
 - carboxyalkylcellulose esters,
 - starches,
 - 35 - pectins such as sodium carboxymethylamylopectin,
 - chitin derivates such as chitosan,
 - heparin and heparinoids,

-31-

- polysaccharides such as alginic acid, alkali metal and ammonium salts thereof, carrageenans, galactomannans, tragacanth, agar-agar, gum arabic, guar gum and xanthan gum,
 - polyacrylic acids and the salts thereof,
 - 5 - polymethacrylic acids and the salts thereof, methacrylate copolymers,
 - polyvinylalcohol,
 - polyvinylpyrrolidone, copolymers of polyvinylpyrrolidone with vinyl acetate,
 - polyalkylene oxides such as polyethylene oxide and polypropylene oxide and copolymers of ethylene oxide and propylene oxide, e.g. poloxamers and
 - 10 poloxamines.
8. The composition of claim 7 wherein the polymer has an apparent viscosity of 1 - 100 mPa.s when dissolved in a 2% aqueous solution at 20°C.
- 15 9. The composition of claim 8 wherein the polymer is hydroxypropylmethylcellulose.
10. The composition of claim 3 wherein the drug is a basic compound.
11. A composition according to any one of the preceding claims that dissolves rapidly
- 20 in body fluids, characterized in that it comprises from 50 to 95 % by weight of acid.
12. A composition according to any one of the preceding claims that provides sustained release of the drug, characterized in that it comprises a water soluble
- 25 polymer having an apparent viscosity of more than 1,000 mPa.s when dissolved in a 2% aqueous solution at 20°C.
13. A pharmaceutical dosage form comprising a therapeutically effective amount of a pharmaceutical composition as defined in any one of the preceding claims.
- 30 14. The dosage form of claim 13 adapted for topical administration or administration into an externally voiding body cavity such as the nose, lungs, mouth, ear, stomach, rectum and vagina.
- 35 15. The dosage form of claim 13 wherein said composition is filled into a standard capsule, or alternatively is mixed with bulking agents and compressed into tablets.
16. The dosage form of claim 13, characterised in that at 5, 15 and 45 minutes after

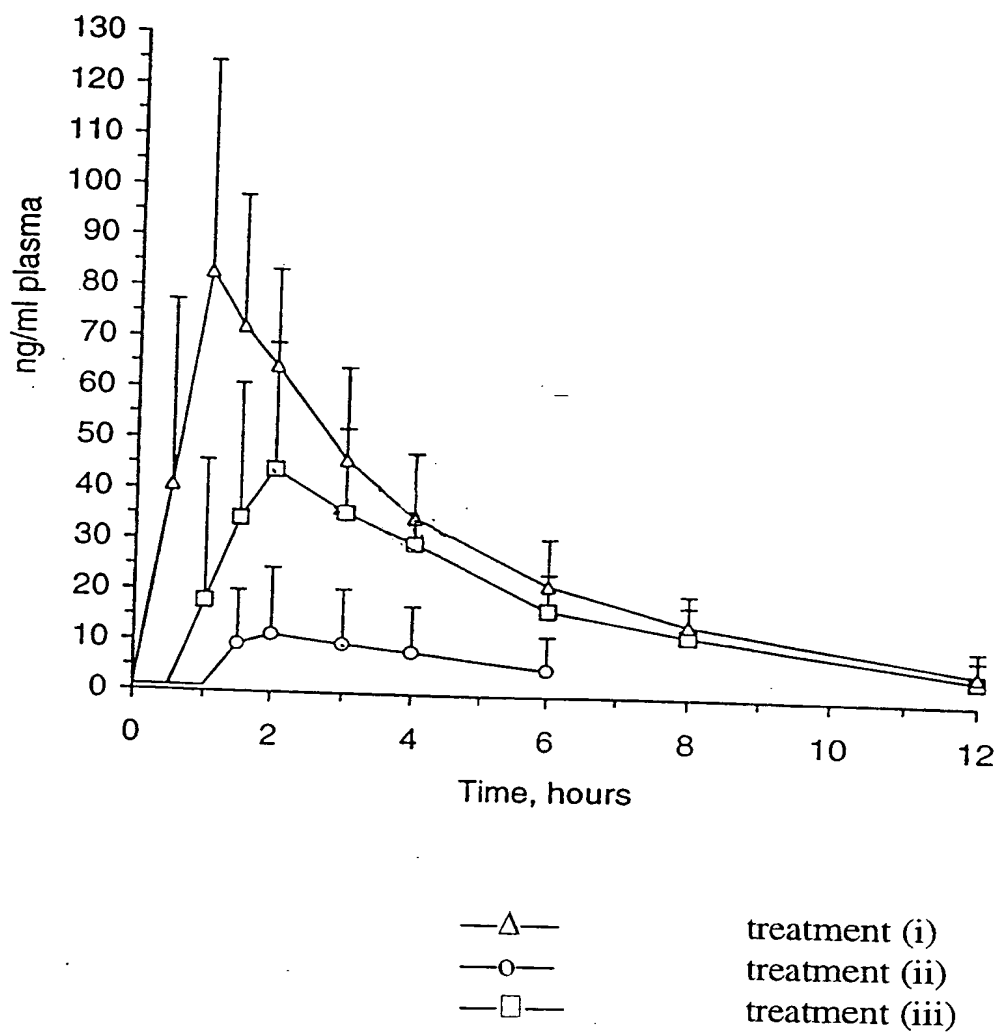
-32-

addition of said dosage form to 0.1N hydrochloric acid at 37°C in the dissolution test set forth in USP test <711> in a USP-2 dissolution apparatus equipped with a paddle, from 7 to 25%, 45 to 70% and at least 96% respectively of drug is dissolved in said 0.1 N hydrochloric acid.

- 5
17. A pharmaceutical composition according to any one of claims 1 to 12 or a pharmaceutical dosage form according to any one of claims 13 to 17 for use in a method of therapy or diagnosis of the human or non-human animal body.
- 10
18. A pharmaceutical composition according to any one of claims 1 to 12 for use in the manufacture of a pharmaceutical dosage form for oral administration to a mammal in need of treatment, characterized in that said dosage form can be administered at any time of the day independently of the food taken in by said mammal.
- 15
19. Use of a pharmaceutical composition according to any one of claims 1 to 12 for the manufacture of a pharmaceutical dosage form for oral administration to a mammal in need of treatment, characterized in that said dosage form can be administered at any time of the day independently of the food taken in by said mammal.
- 20
20. A method of therapy or diagnosis of the human or non-human animal body which comprises administering to said body a therapeutically or diagnostically effective dose of a pharmaceutical composition according to any one of claims 1 to 12.
- 25
21. A pharmaceutical package suitable for commercial sale comprising a container, an oral dosage form as claimed in any one of claims 12 to 17, and associated with said package written matter non-limited as to whether the dosage form can be administered with or without food.

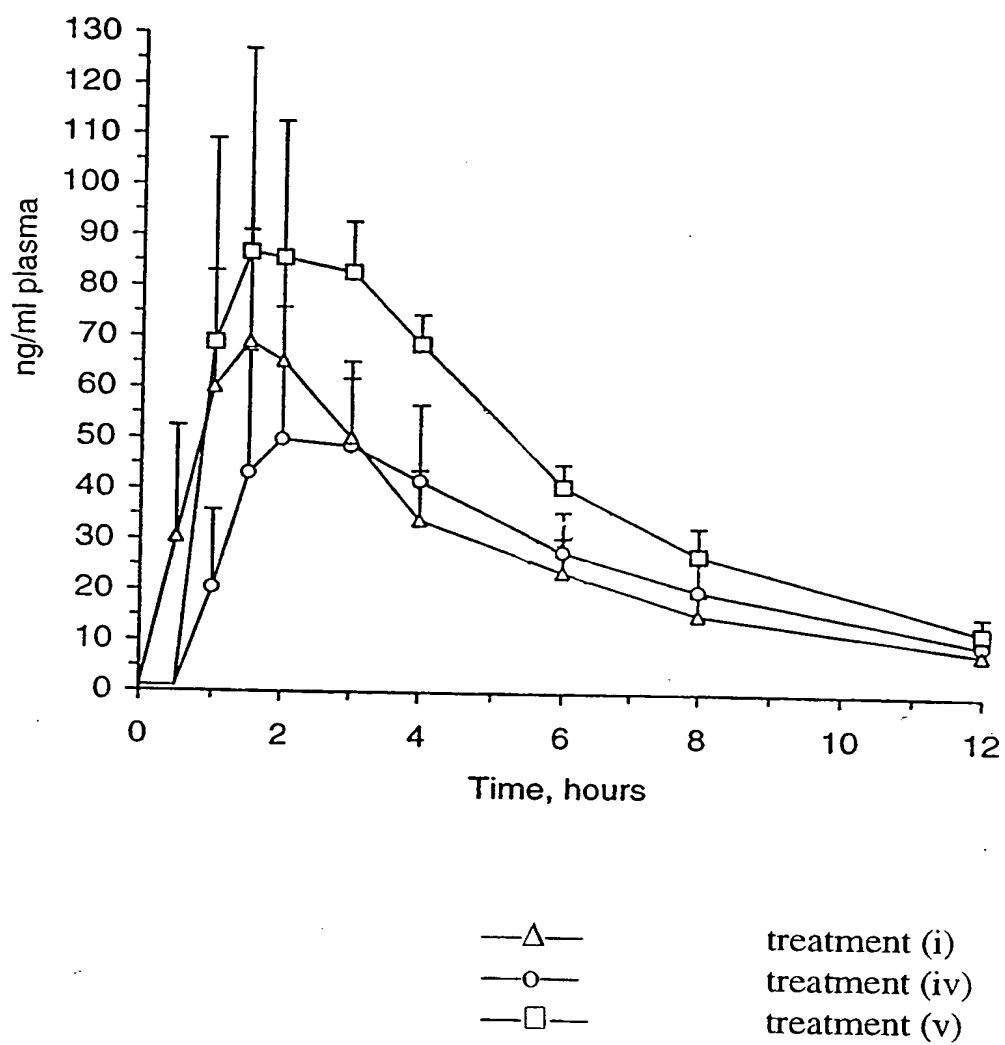
1/3

Figure 1



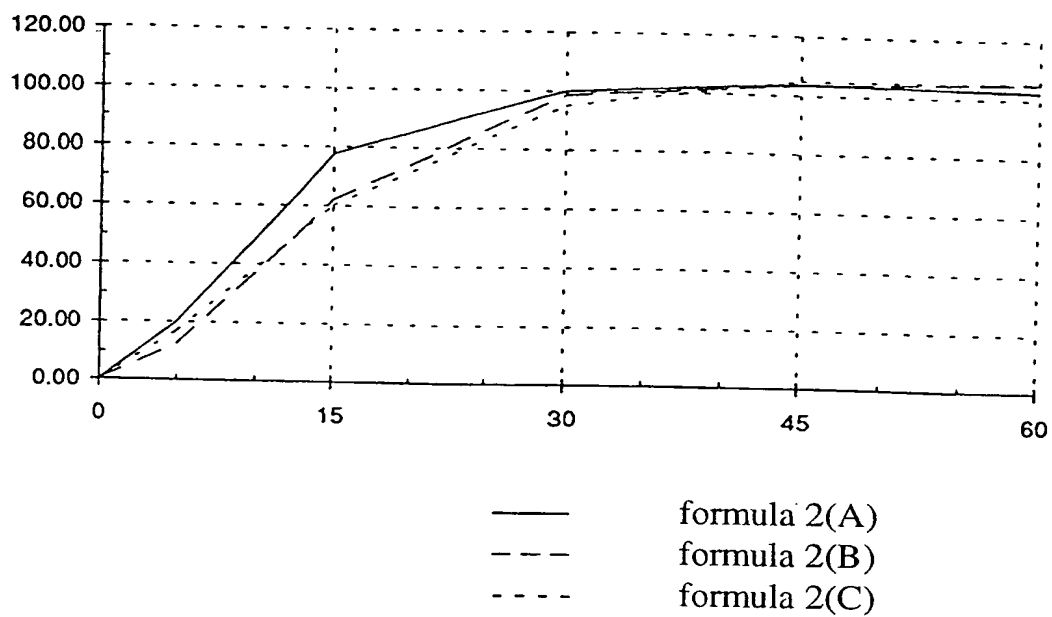
2/3

Figure 2



3/3

Figure 3



INTERNATIONAL SEARCH REPORT

International Application No.

PCT/EP 98/03189

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 A61K47/48 A61K9/14 A61K9/48

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,Y	EP 0 689 844 A (TECNIMEDE SOCIEDADE TECNICO ME) 3 January 1996 see the whole document ---	1,2,4-8, 10,12, 13,15, 17-21
X,Y	WO 94 12217 A (INSITE VISION INC) 9 June 1994 see the whole document ---	1,2, 4-10,12, 13,15, 17-21
X	WO 90 14082 A (CIRD) 29 November 1990 see the whole document --- -/--	1,2,4, 7-9, 12-14, 17-21

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

11 September 1998

Date of mailing of the international search report

18/09/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Fischer, W

INTERNATIONAL SEARCH REPORT

Inter national Application No

PCT/EP 98/03189

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 300 526 A (JANSSEN PHARMACEUTICA NV) 25 January 1989 see the whole document ---	5-7, 14, 17-21
Y	WO 97 18245 A (FARMARC NEDERLAND BV ; GLINTENKAMP LUETA ANN (ZA); PENKLER LAWRENCE) 22 May 1997 see the whole document ---	1, 2, 4, 5, 7, 9, 13, 14, 17-21
A	EP 0 614 666 A (STERLING WINTHROP INC) 14 September 1994 ---	
A	US 5 472 954 A (LOFTSSON THORSTEINN) 5 December 1995 ---	
A	US 4 351 846 A (MIYAKE HAJIMU ET AL) 28 September 1982 ---	
A	US 4 956 351 A (MESENS JEAN L ET AL) 11 September 1990 ---	
A	US 5 206 025 A (COURTEILLE, F. ET AL) 27 April 1993 ---	
A	WO 95 00144 A (HANHIJAERVI HANNU ; LEIRAS OY (FI); OKSALA OLLI (FI); SUHONEN PEKKA) 5 January 1995 ---	
A	EP 0 472 327 A (SENJU PHARMA CO) 26 February 1992 -----	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 98/03189

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0689844	A	03-01-1996	HU 72055 A	28-03-1996
WO 9412217	A	09-06-1994	US 5332582 A	26-07-1994
			AU 672862 B	17-10-1996
			AU 5684194 A	22-06-1994
			CA 2150554 A	09-06-1994
			CN 1103316 A	07-06-1995
			EP 0674528 A	04-10-1995
			JP 8503951 T	30-04-1996
			US 5538721 A	23-07-1996
			ZA 9308945 A	02-08-1994
WO 9014082	A	29-11-1990	FR 2647015 A	23-11-1990
			AU 5668790 A	18-12-1990
			IT 1241141 B	29-12-1993
EP 0300526	A	25-01-1989	AU 611692 B	20-06-1991
			AU 1835288 A	05-01-1989
			CA 1322172 A	14-09-1993
			DK 360988 A	02-01-1989
			FI 883136 A	02-01-1989
			JP 1045319 A	17-02-1989
			PH 26159 A	18-03-1992
			PT 87880 A	30-06-1989
			RU 2016567 C	30-07-1994
			US 4956351 A	11-09-1990
WO 9718245	A	22-05-1997	AU 7637296 A	05-06-1997
EP 0614666	A	14-09-1994	US 5298410 A	29-03-1994
			AU 660843 B	06-07-1995
			AU 4616293 A	01-09-1994
			CA 2106519 A	26-08-1994
			CZ 9400381 A	19-10-1994
			FI 940909 A	26-08-1994
			HU 71586 A	28-12-1995
			IL 108777 A	08-02-1998
			JP 6256222 A	13-09-1994
			MX 9305528 A	31-08-1994
			NO 940663 A	26-08-1994

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 98/03189

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0614666 A		NZ 248590 A	26-07-1995
		SK 23294 A	08-02-1995
		US 5389381 A	14-02-1995
		US 5334382 A	02-08-1994
		US 5529915 A	25-06-1996
US 5472954 A	05-12-1995	US 5324718 A	28-06-1994
		EP 0579435 A	19-01-1994
		SG 49182 A	18-05-1998
US 4351846 A	28-09-1982	JP 1307595 C	13-03-1986
		JP 56158760 A	07-12-1981
		JP 60033430 B	02-08-1985
		DE 3118360 A	15-07-1982
		FR 2482097 A	13-11-1981
		GB 2075976 A, B	25-11-1981
US 4956351 A	11-09-1990	AU 611692 B	20-06-1991
		AU 1835288 A	05-01-1989
		CA 1322172 A	14-09-1993
		DK 360988 A	02-01-1989
		EP 0300526 A	25-01-1989
		FI 883136 A	02-01-1989
		JP 1045319 A	17-02-1989
		PH 26159 A	18-03-1992
		PT 87880 A	30-06-1989
		RU 2016567 C	30-07-1994
US 5206025 A	27-04-1993	FR 2647343 A	30-11-1990
		AU 623779 B	21-05-1992
		AU 5582890 A	10-01-1991
		AU 631888 B	10-12-1992
		AU 5743390 A	18-12-1990
		CA 2017355 A	24-11-1990
		CA 2017360 A	24-11-1990
		DE 69005359 D	03-02-1994
		DE 69005359 T	05-05-1994
		DK 399902 T	14-02-1994
		DK 399903 T	08-02-1993
		EP 0399902 A	28-11-1990